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PRODUCTION OF EXPLOSIVES IN THE UNITED STATES

DURING THE CALENDAR YEAR 1921

WITH NOTES ON MINE ACCIDENTS DUE TO EXPLOSIVES

BY

WILLIAM W. ADAMS

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PRODUCTION AND DISTRIBUTION OF EXPLOSIVES IN THE UNITED STATES DURING THE CALENDAR YEAR 1921.[1]

By WILLIAM W. ADAMS.

INTRODUCTION.

The quantity of explosives sold in the United States during the calendar year 1921 was lower by more than 30 per cent than the amount sold in 1920. Reports received by the Bureau of Mines show that the total sales amounted to 372,107,503 pounds, as compared with 537,954,750 pounds the year before. Of the total amount sold 160,021,250 pounds (43 per cent) was black blasting powder, 170,952,402 pounds (45.9 per cent) "high" explosives other than permissible explosives, and 41,133,851 pounds (11.1 per cent) permissible explosives. As compared with the preceding year these figures indicate a reduction of 37.2 per cent in sales of black powder, 25.4 per cent in "high" explosives, and 23.8 per cent in permissibles. Permissible explosives are those that, because of having passed certain tests prescribed by the Bureau of Mines, are considered reasonably safe for use in gaseous and dusty coal mines.

The coal-mining industry is always the largest consumer of black powder and permissible explosives, the consumption usually comprising about 85 per cent of the entire amount manufactured. In 1921 the coal mines used 5,613,435 kegs, or 140,335,875 pounds, of black powder, 34,231,542 pounds of "high" explosives, and 38,055,650 pounds of permissibles, representing decreases of 36 per cent, 8 per cent, and 16 per cent, respectively, as compared with 1920.

Metal mining and all other mining operations (excluding coal) used 184,792 kegs, or 4,619,800 pounds, of black powder, 50,977,366 pounds of "high" explosives, and 881,710 pounds of permissibles, indicating decreases of 47 per cent, 43 per cent, and 76 per cent, respectively, below the year 1920.

Railroad and other construction work was the only branch of industry using a larger quantity of any kind of explosives than in 1920. This class of work consumed 18,317,333 pounds of dynamite

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[1] In this publication "production" of explosives means the total sales during the year as reported by manufacturers.

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and other high explosives as compared with 15,052,608 pounds the year before, but there was practically no change in the quantity of permissibles, while the consumption of black powder declined from 196,172 kegs in 1920 to 163,688 kegs in 1921.

The quantity of explosives used for miscellaneous purposes fell off 49 per cent for black powder, 59 per cent for permissibles, and 23 per cent for other high explosives.

Pennsylvania, as usual, was by far the leading State in the consumption of explosives, having used 21,458,135 pounds of permissible explosives, 37,809,025 pounds of high explosives other than permissible, and 1,394,869 kegs of black blasting powder. West Virginia was second in the use of permissible explosives, with a consumption of 6,740,025 pounds; Illinois was third, with 3,169,854 pounds; and Alabama was fourth, with 2,580,053 pounds. In the use of high explosives other than permissible, Michigan, with a consumption of 11,745,511 pounds, ranked second to Pennsylvania; California was third, with 11,265,854 pounds; New York was fourth, with 8,847,810 pounds; Minnesota was fifth, with 6,550,971 pounds; and Missouri was sixth, with 6,127,477 pounds. Illinois ranked next to Pennsylvania in the consumption of black blasting powder, having used 1,316,834 kegs.

CLASSIFICATION OF EXPLOSIVES.

The figures tabulated herein are classified as follows:

1. *Black blasting powder.*—All black powder with sodium or potassium nitrate as a constituent is here classified as black blasting powder.

2. *High explosives.*—Dynamite and all other high explosives of various trade names and compositions, except permissible explosives, are put in this class.

3. *Permissible explosives.*—In this class are included ammonium nitrate explosives, hydrated explosives, organic nitrate explosives, and certain nitroglycerin explosives containing an excess of free water or carbon. All permissible explosives have passed certain tests of the Bureau of Mines and are not to be regarded as permissible unless used in the manner specified by the bureau.[2]

ACKNOWLEDGMENTS.

The compilation of this report is made possible by the hearty cooperation of explosives manufacturers and that of Mr. C. Stewart Comeaux, secretary of the Institute of Makers of Explosives. For

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[2] Hall, Clarence, Snelling, W. O., and Howell, S. P., Investigation of explosives used in coal mines, with chapter on the natural gas used at Pittsburgh, by G. A. Burrell, and an introduction by C. E. Munroe: Bull. 15, Bureau of Mines, 1912, 197 pp. Hall, Clarence, and Howell, S. P., Tests of permissible explosives: Bull. 66, Bureau of Mines, 1913, 313 pp.

this cooperation the Bureau of Mines expresses its deep appreciation. The author acknowledges the assistance rendered by Miss L. S. Gerry and Miss E. V. Walters in compiling the statistical tables herein presented.

SCOPE OF STATISTICS.

The data for 1921 presented in this publication are based on the reports of sales of explosives by 26 manufacturers. Of these companies, 21 reported sales of black blasting powder, 21 of high explosives, and 19 of permissible explosives. Some of the manufacturers operated more than one plant, so that the number of companies does not indicate the number of operating plants. Several companies reported their plants as idle during the year.

Reports of manufacturers of ammunition and fireworks are not included in this publication, because the majority of such companies purchase their explosives from the manufacturers whose production has been included in the tables herein presented. Nor does this publication include the production of nitroglycerin, except in so far as nitroglycerin is used in the manufacture of other explosives.

PRODUCTION AND DISTRIBUTION OF EXPLOSIVES.

The quantity of each of the three main classes of explosives used in each State during the calendar years 1920 and 1921 is shown in Table 1. While the decrease in the use of explosives in 1921 was fairly general throughout the country, it will be noted that conditions remained nearly normal in the States of California, Illinois, Indiana, New York, Pennsylvania, and Florida.

TABLE 1.—*Amount of explosives (excluding exports) manufactured in the United States and used in the various States during the calendar years 1920 and 1921.*

State.	1920			1921		
	Black blasting powder.	High explosives other than permissible.	Permissible explosives.	Black blasting powder.	High explosives other than permissible.	Permissible explosives.
	Kegs.	*Pounds.*	*Pounds.*	*Kegs.*	*Pounds.*	*Pounds.*
Alabama	140,259	7,220,796	4,068,974	127,726	3,729,954	2,580,053
Alaska	193	3,360,700	4,300	213	1,734,650	43,300
Arizona	17,154	10,182,462	294,950	7,866	4,138,071	1,250
Arkansas	117,814	2,740,716	208,556	59,101	2,133,065	127,987
California	65,547	11,959,043	1,095	67,442	11,265,854	23,700
Colorado	107,882	4,400,425	966,875	72,623	3,311,252	696,000
Connecticut	667	555,900	150	584	597,015	....
Delaware	63	52,300	....	83	47,093	250
Florida	3,302	2,061,735	157,600	1,300	2,359,325	117,300
Georgia	7,500	916,243	80,650	7,063	444,028	....
Idaho	19,775	3,955,905	550	8,951	2,661,165	....
Illinois	1,952,091	5,154,102	3,398,167	1,316,834	4,774,887	3,169,854
Indiana	1,175,434	2,418,722	618,270	785,104	2,431,374	474,313
Iowa	339,502	2,101,812	64,820	244,084	2,047,464	4,350
Kansas	377,596	6,489,070	75,990	208,045	4,266,383	32,016
Kentucky	845,420	2,274,548	1,416,522	465,607	2,079,211	1,116,375
Louisiana	533	822,403	178,150	72	850,061	156,750
Maine	2,516	656,825	....	1,503	584,442	....

Table 1.—*Amount of explosives (excluding exports) manufactured in the United States and used in the various States during the calendar years 1920 and 1921*—Continued.

State.	1920			1921		
	Black blasting powder.	High explosives other than permissible.	Permissible explosives.	Black blasting powder.	High explosives other than permissible.	Permissible explosives.
	Kegs.	*Pounds.*	*Pounds.*	*Kegs.*	*Pounds.*	*Pounds.*
Maryland and District of Columbia	55,042	1,458,006	263,900	10,082	852,497	52,000
Massachusetts	6,223	574,867	....	4,146	568,730	900
Michigan	20,665	22,891,830	7,750	6,941	11,745,511	31,000
Minnesota	182,922	10,644,333	5,600	112,417	6,550,971	....
Mississippi	1,431	899,185	91,390	2,984	713,215	11,500
Missouri	225,410	7,565,792	219,375	138,333	6,127,477	121,200
Montana	131,506	5,198,495	38,200	74,917	2,607,757	26,360
Nebraska	3,260	270,825	3,200	3,382	167,920	250
Nevada	40,827	3,363,075	3,000	3,897	2,113,800	650
New Hampshire	503	224,275	....	267	146,100	....
New Jersey	2,582	2,481,757	3,275	1,793	1,740,170	3,625
New Mexico	23,596	3,010,360	720,450	7,704	533,550	388,250
New York	16,294	7,444,671	545,340	6,420	8,847,810	414,000
North Carolina	17,168	1,929,759	8,750	21,645	1,524,595	3,850
North Dakota	33,487	381,190	400	30,154	274,725	4,350
Ohio	719,549	6,608,435	237,737	311,970	5,197,631	54,069
Oklahoma	198,867	10,274,443	1,052,675	76,704	5,035,806	413,004
Oregon	36,444	4,343,277	3,200	26,705	3,781,745	2,650
Pennsylvania	1,928,141	39,090,227	23,562,772	1,394,869	37,809,025	21,458,135
Rhode Island	290	88,800	....	209	75,275	....
South Carolina	1,225	434,211	500	1,714	339,400	....
South Dakota	1,553	958,025	10,500	2,851	1,295,240	....
Tennessee	196,685	2,858,252	506,370	108,909	2,323,985	235,575
Texas	61,638	1,919,840	230,963	35,927	1,828,489	84,750
Utah	27,729	3,182,100	3,275,430	12,680	2,591,780	898,850
Vermont	5,135	367,125	....	232	294,150	....
Virginia	134,182	2,944,654	819,500	62,753	2,531,574	387,625
Washington	53,173	7,987,650	879,150	44,478	5,743,941	769,335
West Virginia	737,538	5,331,843	9,402,645	413,634	3,361,061	6,740,025
Wisconsin	2,638	6,558,825	2,100	3,790	4,343,137	500
Wyoming	156,242	502,250	533,050	104,142	430,041	487,900
Total	[a] 10,195,193	229,112,084	53,962,841	[a] 6,400,850	170,952,402	41,133,851
	[b] 254,879,825	....	....	[b] 160,021,250	....	....
Grand total (pounds)	**537,954,750**			**372,107,503**		
Quantity used for:						
Coal mining	8,790,505	37,273,255	45,222,130	5,613,435	34,231,542	38,055,650
Other mining	347,223	89,132,316	3,750,585	184,792	50,977,366	881,710
Railway and other construction work	196,172	15,052,608	266,505	163,688	18,317,333	262,545
All other purposes	861,293	87,653,905	4,723,621	438,935	67,426,161	1,933,946
Total	10,195,193	229,112,084	53,962,841	6,400,850	170,952,402	41,133,851

[a] Kegs of 25 pounds.
[b] Pounds.

BLACK BLASTING POWDER.

Sales of black blasting powder in 1921 fell to a lower level than in any previous year for which annual statistics have been compiled, the first year covered by the figures being 1912. Not only is this statement true for the total amount of powder used, but it is also true for each of the four classes of industry into which consumers of black powder have been segregated.

Of the total quantity of black powder sold in 1921, coal mines used 5,613,435 kegs, or 87.7 per cent; other kinds of mining used 184,792 kegs, or 2.9 per cent; railway and other construction work used 163,688 kegs, or 2.5 per cent; and 438,935 kegs, or 6.9 per cent, were used for all other purposes. The number of kegs used in these four classes of work, when compared with the amount used in 1920, represents a reduction of 36 per cent for coal mining, 47 per cent for other mining, 17 per cent for construction work, and 49 per cent for miscellaneous purposes. As so large a part of all black powder sold in the United States is used in coal mining, the reduction in the quantity used in 1921 largely reflects a loss of 24 per cent in the production of coal during the year, the output of coal having declined from 653,300,000 tons in 1920 to 494,500,000 tons in 1921.

HIGH EXPLOSIVES.

The total quantity of high explosives (other than permissibles) used for all purposes in 1921 was 170,952,402 pounds, a decrease of more than 58,000,000 pounds, or about 25 per cent, below the previous year. The amount sold was lower than in any previous year since 1912, when annual reports of sales were first received by the Bureau of Mines.

Of the total sales in 1921, 34,231,542 pounds, or 20 per cent, was used at coal mines, whereas other kinds of mining consumed 50,977,366 pounds, or 29.8 per cent of the total. Railway and other construction work used 18,317,333 pounds, or 10.7 per cent of the entire production, and represented the only class of work using an increased quantity of high explosives during the past year. Miscellaneous purposes consumed 67,426,161 pounds, or 39.4 per cent.

As compared with 1920, there was a decrease of 3,041,713 pounds of high explosives used at coal mines, a decrease of 38,154,950 pounds for other mining, an increase of 3,264,725 pounds for railway and other construction work, and a decrease of 20,227,744 pounds for miscellaneous purposes.

PERMISSIBLE EXPLOSIVES.

Sales of permissible explosives in 1921 aggregated 41,133,851 pounds, and represent not only a reduction of nearly 13,000,000 pounds, or about 24 per cent below the preceding year's record, but also a lower quantity than was sold either in 1917 or 1918. Except for these three years, however, more permissibles were sold in 1921 than in any preceding year. They are fast replacing other high explosives and black blasting powder in coal-mining operations.

Of the total sales of permissibles in 1921, the mining industry consumed 94.7 per cent, as compared with 90.7 per cent in 1920. Coal mining consumed 38,055,650 pounds (92.5 per cent) and other mining used 881,710 pounds (2.1 per cent). Railroad and other construction work used only 262,545 pounds, or about six-tenths of 1 per cent.

Miscellaneous purposes used 1,933,946 pounds, or 4.7 per cent of the total.

The quantity of permissibles used in coal mining, though about 7,000,000 pounds, or 15 per cent, lower than in 1920, was greater than in any year preceding 1920.

The quantity of permissibles used at mines other than coal mines underwent an unusual decline, the reports showing 3,750,585 pounds in 1920 and 881,710 pounds in 1921, a reduction of 76 per cent, brought about by the dormant state of metalliferous mining during the past year. Railroad and other classes of construction work consumed practically the same quantity of permissibles as in the preceding year. Consumption for miscellaneous purposes declined 59 per cent or from 4,723,621 pounds to 1,933,946 pounds.

TABLE 2.—*Amount of black blasting powder used in the United States during 1920 and 1921, classified by use.*

[Kegs of 25 pounds each.]

Groups of States.	Black blasting powder, 1920.				Black blasting powder, 1921.			
	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.
	Kegs.	*Kegs.*	*Kegs.*	*Kegs.*	*Kegs.*	*Kegs.*	*Kegs.*	*Kegs.*
Group 1. Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont			33	14,634			55	6,302
Group 2. Connecticut, New Jersey, and New York		950	146	18,447		711	372	7,714
Group 3. Delaware, District of Columbia, Maryland, and Virginia	174,504	826	3,112	10,845	59,737	105	4,966	8,110
Pennsylvania	1,695,702	7,892	4,057	220,490	1,314,089	2,990	3,231	74,559
West Virginia	662,491	1,840	17,014	56,193	380,623	740	15,713	16,558
Group 4. Florida, Georgia, North Carolina, and South Carolina	2,101	5,178	9,408	12,508	1,715	2,914	16,470	10,623
Group 5. Indiana and Kentucky	1,912,365	6,569	9,883	92,037	1,187,665	5,022	14,650	43,374
Illinois	1,874,878	3,928	708	72,577	1,279,988	2,898	230	33,718
Ohio	662,374	10,740	198	46,237	286,833	13,749	2,532	8,856
Group 6. Alabama, Mississippi, and Tennessee	284,872	18,740	11,073	23,690	201,634	6,779	11,852	19,354
Group 7. Michigan, Minnesota, and Wisconsin	13,777	186,282	1,373	4,793	6,844	109,399	1,469	5,436
Group 8. Iowa, Kansas, Missouri, and Nebraska	868,505	11,983	10,167	55,113	528,180	13,491	10,885	41,288
Group 9. Arkansas, Louisiana, Oklahoma, and Texas	317,775	3,811	22,674	34,592	141,609	1,877	9,921	18,397
Group 10. Montana, North Dakota, South Dakota, and Wyoming	214,562	18,531	5,523	84,172	136,189	10,033	1,883	63,959
Group 11. Colorado, New Mexico, and Utah	80,095	26,800	14,258	38,054	62,126	5,450	5,661	19,770
Group 12. Alaska, Idaho, Oregon, and Washington	26,504	1,733	49,514	31,834	26,203	815	26,213	27,116
Group 13. Arizona, California, and Nevada		41,420	37,031	45,077		7,819	37,585	33,801
Total (kegs)	8,790,505	347,223	196,172	861,293	5,613,435	184,792	163,688	438,935
Grand total (kegs)	**10,195,193**				**6,400,850**			

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TABLE 3.—*Amount of high explosives used in the United States during 1920 and 1921, classified by use.*

Groups of States.	High explosives other than permissible explosives, 1920.				High explosives other than permissible explosives, 1921.			
	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Group 1. Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont	....	52,400	201,229	1,658,263	....	32,000	190,375	1,446,322
Group 2. Connecticut, New Jersey, and New York	....	4,370,087	1,065,442	5,046,799	....	3,498,375	2,778,463	4,908,157
Group 3. Delaware, District of Columbia, Maryland, and Virginia	938,323	335,900	367,750	2,812,987	401,250	205,750	560,425	2,263,739
Pennsylvania	22,822,640	272,821	604,359	15,390,407	25,765,280	185,175	1,105,034	10,753,536
West Virginia	1,631,477	48,800	1,054,378	2,597,188	853,841	24,850	888,736	1,593,634
Group 4. Florida, Georgia, North Carolina, and South Carolina	52,700	594,147	998,803	3,696,298	1,450	451,670	1,252,792	2,961,436
Group 5. Indiana and Kentucky	1,231,080	220,576	475,418	2,766,196	901,205	235,400	690,833	2,683,147
Illinois	706,240	1,784,325	189,434	2,474,103	535,803	1,830,850	412,690	1,995,544
Ohio	861,417	210,100	160,209	5,376,709	641,421	339,775	186,816	4,029,619
Group 6. Alabama, Mississippi, and Tennessee	2,494,742	4,880,177	826,598	2,776,716	1,520,525	2,265,260	1,288,290	1,693,079
Group 7. Michigan, Minnesota, and Wisconsin	96,600	28,259,090	458,360	11,280,938	76,036	14,004,123	927,025	7,632,435
Group 8. Iowa, Kansas, Missouri, and Nebraska	4,066,111	6,963,250	816,125	4,582,013	2,096,337	5,825,540	724,728	3,962,639
Group 9. Arkansas, Louisiana, Oklahoma, and Texas	712,720	9,764,128	1,327,608	3,952,946	583,894	4,571,430	1,279,651	3,412,446
Group 10. Montana, North Dakota, South Dakota, and Wyoming	386,889	5,535,555	103,905	1,013,611	331,975	3,310,022	115,485	850,281
Group 11. Colorado, New Mexico, and Utah	460,120	6,079,430	129,750	3,923,585	303,075	2,721,000	127,735	3,284,772
Group 12. Alaska, Idaho, Oregon, and Washington	812,196	5,375,790	3,636,535	9,823,011	219,450	3,925,800	3,914,707	5,861,544
Group 13. Arizona, California, and Nevada	....	14,385,740	2,636,705	8,482,135	....	7,550,346	1,873,548	8,093,831
Total (pounds)	37,273,255	89,132,316	15,052,608	87,653,905	34,231,542	50,977,366	18,317,333	67,426,161
Grand total (pounds)	**229,112,084**				**170,952,402**			

TABLE 4.—*Amount of permissible explosives used in the United States during 1920 and 1921, classified by use.*

Groups of States.	Permissible explosives, 1920.				Permissible explosives, 1921.			
	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Group 1. Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont	....	....	....	....	....	....	....	900
Group 2. Connecticut, New Jersey, and New York	....	502,640	....	46,125	....	334,700	....	82,925
Group 3. Delaware, District of Columbia, Maryland, and Virginia	851,350	83,500	20,250	128,300	381,950	26,150	5,500	26,275
Pennsylvania	21,772,959	13,700	23,267	1,752,846	20,965,619	6,700	32,710	453,106
West Virginia	8,382,184	55,100	88,111	877,250	6,203,528	25,400	131,063	380,034
Group 4. Florida, Georgia, North Carolina, and South Carolina	50	143,000	....	104,450	1,600	97,800	3,000	18,750
Group 5. Indiana and Kentucky	1,819,329	30,675	24,288	160,500	1,445,938	9,500	1,300	133,950
Illinois	3,366,727	17,425	150	13,865	3,164,504	....	200	5,150
Ohio	41,366	2,000	....	194,371	22,725	2,000	100	29,244
Group 6. Alabama, Mississippi, and Tennessee	4,293,934	233,760	17,000	122,040	2,779,083	16,150	7,300	24,595
Group 7. Michigan, Minnesota, and Wisconsin	....	6,300	....	9,150	500	24,350	....	6,650
Group 8. Iowa, Kansas, Missouri, and Nebraska	63,680	76,320	2,400	220,985	33,016	2,450	6,250	116,100
Group 9. Arkansas, Louisiana, Oklahoma, and Texas	1,123,491	121,205	9,614	416,034	460,362	....	41,312	280,817
Group 10. Montana, North Dakota, South Dakota, and Wyoming	152,150	144,400	....	285,600	228,700	111,210	....	178,700
Group 11. Colorado, New Mexico, and Utah	2,592,210	2,075,200	51,075	244,270	1,626,100	219,700	3,350	133,950
Group 12. Alaska, Idaho, Oregon, and Washington	762,350	15,850	30,150	78,850	738,575	3,700	27,360	45,650
Group 13. Arizona, California, and Nevada	350	229,510	200	68,985	3,450	1,900	3,100	17,150
Total (pounds)	45,222,130	3,750,585	266,505	4,723,621	38,055,650	881,710	262,545	1,933,946
Grand total (pounds)	**53,962,841**				**41,133,851**			

EXPLOSIVES IN COAL MINING.

Mining operations generally consume about 75 per cent of all explosives used in the United States. Coal mining consumes between 80 and 85 per cent of all black powder and permissible explosives used in this country, and about 15 per cent of other high explosives. Other mining and quarrying operations (excluding coal mines and oil and gas wells) normally consume 40 to 50 per cent of all high explosives other than permissibles, 6 to 17 per cent of permissible explosives, and 3 to 4 per cent of black powder. It will thus be seen that most of the explosives used in mining operations are used at coal mines. (Tables 11 and 12.)

The main purpose of the Bureau of Mines in compiling statistics of explosives is to show the extent to which permissible or "safety" explosives are replacing other classes of explosives in mining operations and the influence of such replacement in reducing the number of mine accidents caused by explosives. It is interesting, therefore, to note the relative increase or decrease in the consumption of each of the three main classes of explosives at coal mines as compared with the production of coal. Comparative figures since 1912, given in Table 5, show a most gratifying increase in the use of permissibles. For every thousand tons of coal produced the relative amount of permissibles used, as compared with other explosives, has increased 126 per cent since 1912; black powder has decreased 19 per cent, and high explosives have increased 77 per cent.

Tables 5, 6, and 7 show, for the different coal fields and regions, the annual production of coal and the quantities of each class of explosives sold for use in coal-mining operations. It will be noted that in 1902 only 11,300 pounds of short-flame or "safety" explosives were used in coal mining, whereas in 1921 the quantity of permissible explosives so used was 38,055,650 pounds. In 1912 the quantity consumed represented about 5 per cent of the total quantity of explosives produced in this country, and in 1921 it was 11.1 per cent. The total amount of explosives used for the production of coal in 1921 was 212,623,067 pounds, of which nearly 18 per cent was of the permissible class. (Tables 4, 5, 6, 7, 11, and 12.)

TABLE 5.—*Yearly sales of explosives to coal mines compared with yearly production of coal.*

Year.	Production of coal (short tons).	Pounds of explosives sold to coal mines.			Pounds of explosives used per 1,000 tons of coal mined.[a]			
		Permissible explosives.	High explosives.	Black powder.	Permissible explosives.	High explosives.	Black powder.	Total.
1901	293, 299, 816	....	....	....	....	....	....	....
1902	301, 590, 434	11, 300	....	....	....	....	....	....
1903	357, 356, 416	288, 661	....	....	....	....	....	....
1904	351, 816, 398	608, 270	....	....	....	....	....	....
1905	392, 722, 635	1, 031, 300	....	....	....	....	....	....
1906	414, 157, 278	1, 533, 575	....	....	....	....	....	....
1907	480, 363, 424	2, 095, 244	....	....	....	....	....	....
1908	415, 842, 698	2, 108, 610	....	....	....	....	....	....
1909	460, 814, 616	8, 942, 857	....	....	....	....	....	....
1910	501, 596, 378	11, 820, 836	....	....	....	....	....	....
1911	496, 371, 126	13, 428, 239	....	....	27	....	....	....
1912	534, 466, 580	18, 150, 618	20, 903, 430	187, 091, 000	34	39	350	423
1913	570, 048, 125	21, 804, 285	24, 143, 133	184, 917, 075	38	42	325	405
1914	513, 525, 477	19, 593, 892	24, 215, 945	176, 812, 650	38	47	345	430
1915	531, 619, 487	21, 841, 659	22, 384, 025	167, 513, 950	41	42	315	398
1916	590, 098, 175	26, 566, 521	20, 901, 405	176, 976, 025	45	35	300	380
1917	651, 402, 374	32, 910, 397	28, 262, 807	235, 750, 300	51	43	362	456
1918	678, 211, 904	37, 262, 915	31, 368, 073	216, 221, 550	55	46	319	420
1919	553, 952, 259	32, 840, 196	29, 616, 383	153, 490, 125	59	53	277	390
1920	[b]653, 332, 632	45, 222, 130	37, 273, 255	219, 762, 625	69	57	336	463
1921	[c]494, 500, 000	38, 055, 650	34, 231, 542	140, 335, 875	77	69	284	430

[a] The figures show the relation that the consumption of each class of explosives bears to the total quantity of explosives used in producing coal; except in the last column they do not indicate the quantity of coal broken down by any given quantity of explosives.

[b] Excluding product of wagon mines.

[c] Estimated.

TABLE 6.—*Quantity of explosives used in the different coal fields in the United States.*[a]

Coal fields and regions.	Black blasting powder (kegs).					High explosives other than permissible (pounds).				
	1917	1918	1919	1920	1921	1917	1918	1919	1920	1921
1. Pennsylvania anthracite field	1,430,169	1,212,172	1,018,685	923,423	954,451	16,074,125	16,709,256	17,800,259	19,278,375	22,832,825
2. Northern Appalachian region[b]	2,372,303	1,967,012	1,529,511	2,271,648	1,086,831	4,592,547	5,320,401	4,561,368	6,975,482	4,828,967
3. Southern Appalachian region	845,553	815,785	656,037	1,050,068	623,094	1,519,234	2,202,700	1,867,150	3,221,212	1,971,317
4. Eastern interior field	2,974,925	3,034,820	1,876,849	3,037,925	2,054,752	994,166	1,121,958	904,826	1,360,150	1,063,702
5. Western interior field	1,478,311	1,319,401	838,599	1,186,280	669,789	3,185,290	4,067,393	3,642,960	4,778,831	2,680,231
6. Rocky Mountain region	304,544	279,039	206,099	294,657	198,315	1,154,495	1,347,240	596,170	847,009	635,050
7. Pacific coast region	24,207	20,633	13,825	26,504	26,203	742,950	599,125	243,650	812,196	219,450
Total	**9,430,012**	**8,648,862**	**6,139,605**	**8,790,505**	**5,613,435**	**28,262,807**	**31,368,073**	**29,616,383**	**37,273,255**	**34,231,542**

Coal fields and regions.	Permissible explosives (pounds).									
	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921
1. Pennsylvania anthracite field	2,177,172	3,294,225	4,380,635	5,037,050	5,219,032	7,298,925	7,654,250	8,579,643	8,558,690	11,921,675
2. Northern Appalachian region[b]	9,190,025	9,744,810	7,966,464	9,435,318	12,147,207	14,505,542	17,007,369	14,626,371	22,489,169	15,652,147
3. Southern Appalachian region	3,995,485	4,481,975	3,510,013	3,447,964	4,386,757	5,287,755	5,764,886	4,210,184	5,573,168	3,809,408
4. Eastern interior field	751,005	2,058,075	1,364,450	1,631,775	1,949,925	2,403,600	2,873,846	2,542,290	3,906,872	3,582,217
5. Western interior field	440,825	377,625	411,937	433,010	422,425	624,045	930,444	642,938	1,187,171	493,378
6. Rocky Mountain region	1,473,129	1,634,575	1,796,750	1,710,992	2,244,275	2,423,180	2,622,520	1,882,770	2,744,360	1,854,800
7. Pacific coast region	122,977	213,000	163,643	145,550	196,900	367,350	409,600	356,000	762,700	742,025
Total	**18,150,618**	**21,804,285**	**19,593,892**	**21,841,659**	**26,566,521**	**32,910,397**	**37,262,915**	**32,840,196**	**45,222,130**	**38,055,650**

[a] The various coal fields include the following States: Group 1 includes the Pennsylvania anthracite field only; group 2 includes Pennsylvania bituminous, Maryland, West Virginia, Ohio, and Virginia; group 3 includes Alabama, Georgia, North Carolina, Tennessee, and Kentucky; group 4 includes Illinois, Indiana, Michigan, and Wisconsin; group 5 includes Iowa, Missouri, Arkansas, Texas, Oklahoma, and Kansas; group 6 includes Colorado, Idaho, North Dakota, South Dakota, Montana, Utah, Wyoming, Nevada, and New Mexico; and group 7 includes Alaska, California, Oregon, and Washington.

[b] Not including Pennsylvania anthracite field.

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TABLE 7.—*Quantity of coal mined in different coal fields in the United States.*

Coal fields and regions.	1912	1913	1914	1915	1916	1917	1918	1919	1920
1. Pennsylvania anthracite field	84,361,598	91,524,922	90,821,507	88,995,061	87,578,493	99,611,811	98,826,084	88,092,201	89,598,249
2. Northern Appalachian region[a]	275,991,578	294,898,633	250,627,117	269,876,970	305,651,290	314,471,558	329,086,628	278,019,905	318,085,090
3. Southern Appalachian region	39,292,052	44,454,532	42,085,941	42,154,468	49,791,197	54,189,294	57,696,763	50,846,313	58,316,185
4. Eastern interior field	76,377,174	80,016,201	75,513,359	76,991,866	87,469,224	114,113,521	121,434,557	82,771,441	119,209,243
5. Western interior field	26,580,416	27,875,292	26,396,916	25,684,804	26,474,830	30,707,592	30,723,823	21,741,003	27,375,788
6. Rocky Mountain region	28,449,860	27,327,452	24,950,285	25,434,089	30,031,648	34,209,991	36,266,503	29,411,536	36,913,156
7. Pacific coast region	3,413,902	3,951,093	3,130,352	2,482,229	3,101,493	4,098,607	4,177,546	3,069,860	3,834,921
Total	**534,466,580**	**570,048,125**	**513,525,477**	**531,619,487**	**590,098,175**	**651,402,374**	**678,211,904**	**553,952,259**	[b] **653,332,632**

[a] No including Pennsylvania anthracite field.

[b] Excluding product of wagon mines.

MINE FATALITIES DUE TO EXPLOSIVES.

Accidents in the mining industry due to the use of explosives during the past ten years have caused 4 to 9 per cent of all fatalities at coal mines, 9 to 14 per cent at metal mines, and 13 to 26 per cent at quarries. No data are available regarding nonfatal accidents at coal mines, but the record shows that only 1.6 per cent of all injuries at metal mines and about 2.8 of those at quarries have been due to the use of explosives. For every fatality due to explosives since 1911, there have been 7.3 nonfatal injuries at metal mines and 7.8 nonfatal injuries at quarries. Considered in relation to the number of men employed, there has been a general decline in the number of fatalities from explosives, although the rate has fluctuated from year to year, as shown by Table 8. A decrease is also noted in the injury rate caused by explosives at quarries, but the rate for metal mines has remained nearly stationary. Fatalities at coal mines since 1911, are presented in Table 9; the figures show that 37 to 61 per cent of the fatalities occurred at the anthracite mines in Pennsylvania. In 1919 the figure for anthracite mines was abnormally high (149, or 72 per cent) due to a powder explosion in Baltimore Tunnel No. 2, at Wilkes-Barre, on June 5, which caused the death of 92 men.

Table 10 shows the causes of fatalities and injuries due to explosives in the mining industry in 1920. About 40 per cent of the fatalities and 10 per cent of the injuries were due to premature shots.

TABLE 8.—*Fatalities and injuries due to explosives at mines and quarries, and rates per 1,000 men employed (300-day workers).*

	Bituminous coal mines.			Anthracite and bituminous mines.			Metal mines.						Quarries.					
	Killed.	Per cent.	Rate.	Killed.	Per cent.	Rate.	Killed.	Per cent.	Rate.	Injured.	Per cent.	Rate.	Killed.	Per cent.	Rate.	Injured.	Per cent.	Rate.
1901																		
1902																		
1903	138	9.80																
1904	121	8.64																
1905	119	7.49																
1906	115	7.27																
1907	134	5.29																
1908	109	6.17																
1909	122	5.88																
1910	113	5.09																
1911	72	3.68	.184	160	6.02	.299	78	11.22	.500	531	2.00	3.40	50	26.60	.592	341	6.33	4.04
1912	70	3.85	.171	147	6.08	.271	94	14.22	.581	573	1.86	3.54	47	22.06	.501	260	3.97	2.77
1913	63	2.91	.142	138	4.96	.232	89	13.03	.485	579	1.76	3.15	44	24.04	.505	332	4.29	3.81
1914	56	3.01	.147	146	5.95	.277	60	10.73	.421	464	1.54	3.25	35	19.44	.513	265	3.38	3.89
1915	76	4.52	.202	155	6.83	.303	78	14.10	.549	388	1.10	2.73	28	18.92	.339	227	2.35	2.75
1916	60	3.59	.139	146	6.56	.258	89	12.77	.462	870	1.80	4.52	28	16.18	.366	338	2.52	4.42
1917	55	2.60	.112	110	4.08	.173	79	9.27	.411	617	1.33	3.21	21	16.03	.294	271	2.05	3.79
1918	85	4.19	.166	135	5.23	.206	89	13.78	.492	657	1.53	3.63	17	13.60	.286	151	1.73	2.55
1919	57	3.39	.141	206	8.89	.380	48	10.26	.352	412	1.31	3.05	24	19.51	.376	167	1.81	2.62
1920	79	4.44		128	5.64	.213	57	13.41	.424	496	1.52	3.69	36	20.23	.467	214	1.91	2.78
1921	84	5.88		152	7.70													

TABLE 9.—*Coal-mine fatalities underground due to explosives, 1911–1921.*

States.	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921
Pennsylvania (anthracite)	88	77	75	90	79	86	55	50	[a]149	49	68
Pennsylvania (bituminous)	6	8	4	7	9	10	6	6	17	22	15
West Virginia	3	8	8	5	6	3	6	14	6	12	14
Illinois	15	11	11	9	11	6	9	12	2	9	11
Ohio	3	5	6	2	3	5	4	8	10	9	3
Indiana, Michigan, and Kentucky	15	3	5	12	12	10	14	20	11	9	26
Alabama, Tennessee, Georgia, and North Carolina	6	6	2	2	10	3	3	5	3	6	9
Iowa, Kansas, and Missouri	4	14	6	4	13	9	2	7	2	3	1
Colorado, New Mexico, and Utah	3	1	7	4	......	4	3	3	1	4	......
Maryland and Virginia	......	10	2	......	4	3	2	5	2	......	......
Montana, North Dakota, and Wyoming	4	2	4	4	3	2	2	1	2	1	......
Arkansas, Oklahoma, and Texas	11	1	5	4	5	1	4	4	......	3	3
Alaska, California, Idaho, Nevada, Oregon, and Washington	2	1	3	3	......	4	......	......	1	......	2
Total underground	**160**	**147**	**138**	**146**	**155**	**146**	**110**	**135**	**206**	**127**	**152**

[a] Of this number, 92 men were killed in the powder explosion in Baltimore Tunnel No. 2, Wilkes-Barre, Pa., on June 5, 1919.

TABLE 10.—*Fatalities and injuries due to explosives in the mineral industry, 1920.*

KILLED.

	Transportation.	Charging.	Suffocation.	Drilling into old holes.	Striking into loose rock or ore.	Thawing.	Caps, detonators, etc.	Unguarded shots.	Returned too soon.	Premature shots.	Sparks from match, lamp, or candle.	Delayed blast.	Shot breaking through rib or pillar.	Miscellaneous.	**Total.**
Quarries	....	12	....	3	1	....	1	2	3	11	....	2	....	1	36
Coal mines (underground)	3	4	4	3	....	....	3	2	12	56	5	13	1	21	127
Metal mines (underground)	....	....	....	....	....	....	1	2	....	1	....	....	....	2	6
Metal mines (open pit)	....	1	....	....	....	....	....	....	....	1	....	....	....	....	2
Total	**3**	**17**	**4**	**6**	**1**	....	**5**	**6**	**15**	**69**	**5**	**15**	**1**	**24**	**171**

INJURED.

	Transportation.	Charging.	Suffocation.	Drilling into old holes.	Striking into loose rock or ore.	Thawing.	Caps, detonators, etc.	Unguarded shots.	Returned too soon.	Premature shots.	Sparks from match, lamp, or candle.	Delayed blast.	Shot breaking through rib or pillar.	Miscellaneous.	**Total.**
Quarries	8	8	....	16	5	5	13	2	13	22	....	13	....	109	214
Coal mines (underground)	([a])	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Metal mines (underground)	5	4	17	11	4	....	5	18	23	18	....	....	....	67	[b]172
Metal mines (open pit)	1	3	....	....	....	....	....	2	....	2	....	....	....	19	[b]27
Total	**14**	**15**	**17**	**27**	**9**	**5**	**18**	**22**	**36**	**42**	....	**13**	....	**195**	**413**

[a] Not available.

[b] From selected returns only. Details as to subdivisions not available for all metal mines.

Table 11.—*Percentage of explosives used for various purposes in the United States during the years 1915 to 1921.*

	Coal mining.	Other mining.	Railway and other construction work.	All other purposes.	Total.
1921.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Black blasting powder	87.7	2.9	2.5	6.9	100.00
High explosives	20.0	29.8	10.7	39.5	100.00
Permissible explosives	92.5	2.1	.7	4.7	100.00
Total	**57.1**	**15.2**	**6.1**	**21.6**	**100.00**
1920.					
Black blasting powder	86.2	3.4	1.9	8.5	100.00
High explosives	16.3	38.9	6.6	38.2	100.00
Permissible explosives	83.8	6.9	.5	8.8	100.00
Total	**56.2**	**18.9**	**3.7**	**21.2**	**100.00**
1919.					
Black blasting powder	85.0	3.5	2.8	8.7	100.00
High explosives	14.9	45.3	6.4	33.4	100.00
Permissible explosives	84.5	6.4	.5	8.6	100.00
Total	**51.7**	**23.6**	**4.3**	**20.4**	**100.00**
1918.					
Black blasting powder	87.7	3.0	2.2	7.1	100.00
High explosives	15.2	49.6	5.8	29.4	100.00
Permissible explosives	80.9	9.9	.4	8.8	100.00
Total	**57.1**	**22.9**	**3.5**	**16.5**	**100.00**
1917.					
Black blasting powder	85.1	3.4	4.7	6.8	100.00
High explosives	10.8	50.4	7.8	31.0	100.00
Permissible explosives	76.5	14.2	.2	9.1	100.00
Total	**51.0**	**25.4**	**5.7**	**17.9**	**100.00**
1916.					
Black blasting powder	82.1	3.6	5.0	9.3	100.00
High explosives	8.2	51.6	8.6	31.6	100.00
Permissible explosives	76.6	17.9	.3	5.2	100.00
Total	**44.4**	**28.8**	**6.5**	**20.3**	**100.00**
1915.					
Black blasting powder	84.8	3.4	3.6	8.2	100.00
High explosives	9.5	46.3	9.4	34.9	100.00
Permissible explosives	79.9	17.1	.5	2.5	100.00
Total	**45.9**	**26.1**	**6.4**	**21.5**	**100.00**

TABLE 12.—*Production of explosives in the United States from 1912 to 1921.*

[Excluding exports.]

	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921
Black blasting powder (kegs of 25 pounds):										
Quantity used for coal mining	7,483,640	,396,683	7,072,506	6,700,558	7,079,041	9,430,012	8,648,862	6,139,605	8,790,505	5,613,435
Quantity used for other mining	1,728,095	334,014	302,885	268,146	313,851	378,199	297,818	252,134	347,223	184,792
Quantity used for railway and other construction work		626,474	316,131	289,869	428,853	516,892	219,260	204,197	196,172	163,688
Quantity used for all other purposes		840,410	552,466	650,319	801,256	759,638	700,594	624,506	861,293	438,935
Total	**9,211,735**	**9,197,581**	**8,243,988**	**7,908,892**	**8,623,001**	**11,084,741**	**9,866,534**	**7,220,442**	**10,195,193**	**6,400,850**
High explosives other than permissible (pounds):										
Quantity used for coal mining	20,903,430	24,143,133	24,215,945	22,384,025	20,901,405	28,262,807	31,368,073	29,616,383	37,273,255	34,231,542
Quantity used for other mining	89,703,081	92,096,426	84,264,577	109,128,966	131,753,648	132,235,515	102,366,876	89,754,788	89,132,316	50,977,366
Quantity used for railway and other construction work	123,862,981	33,173,805	27,983,946	22,279,699	21,905,376	20,418,227	12,081,541	12,759,623	15,052,608	18,317,333
Quantity used for all other purposes		92,973,180	81,989,503	82,035,897	80,594,358	81,399,531	60,599,587	66,137,794	87,653,905	67,426,161
Total	**234,469,492**	**242,386,544**	**218,453,971**	**235,828,587**	**255,154,787**	**262,316,080**	**206,416,077**	**198,268,588**	**229,112,084**	**170,952,402**
Permissible explosives (pounds):										
Quantity used for coal mining	18,150,618	21,804,285	19,593,892	21,841,659	26,566,521	32,910,397	37,262,915	32,840,196	45,222,130	38,055,650
Quantity used for other mining	4,668,399	4,735,480	4,850,241	4,687,510	6,206,558	6,102,225	4,550,130	2,498,132	3,750,585	881,710
Quantity used for railway and other construction work	1,811,253	424,575	281,425	139,843	97,100	106,185	183,380	183,353	266,505	262,545
Quantity used for all other purposes		721,430	972,260	680,897	1,815,061	3,921,915	4,048,808	3,333,151	4,723,621	1,933,946
Total	**24,630,270**	**27,685,770**	**25,697,818**	**27,349,909**	**34,685,240**	**43,040,722**	**46,045,233**	**38,854,832**	**53,962,841**	**41,133,851**

AMMONIUM NITRATE IN PERMISSIBLE EXPLOSIVES.

At the close of the calendar year 1920 the bureau received special reports from all manufacturers of permissible explosives showing the quantity of each brand of permissible sold during the year. Similar reports have been received for 1921. A study of the reports for 1920 by S. P. Howell, explosives engineer of the Bureau of Mines, showed that 90 per cent of all permissible explosives sold during 1920 belonged to the ammonium nitrate class (Class 1a). The total quantity of commercial ammonium nitrate used in permissible explosives during 1920 aggregated 31,831,000 pounds. According to Mr. Howell, the reports for 1921 show that "93.5 per cent of all permissible explosives sold during 1921 belonged to the ammonium nitrate class (Class 1a). The total quantity of commercial ammonium nitrate used in permissible explosives during 1921 aggregated 25,381,500 pounds; the total quantity of nitroglycerin and 'modified' nitroglycerin used in permissible explosives aggregated 3,974,000 pounds for the manufacture of which approximately 1,766,000 pounds of glycerin were used. By 'modified' nitroglycerin is meant the products obtained by the nitration of a mixture of glycerin and certain compounds."

MONTHLY SALES OF EXPLOSIVES.

Table 13 shows the monthly fluctuations in the sales of explosives during the past two years. It is based on monthly reports by manufacturers who are members of the Institute of Makers of Explosives. Most of the manufacturing companies are members of the institute, and their sales during 1921 represented more than 90 per cent of all sales of black blasting powder, 92 per cent of high explosives (other than permissibles), and over 99 per cent of permissible explosives. Reports from nonmembers are received by the bureau in the form of an annual summary, hence it was not possible to segregate on a monthly basis the data for those companies.

The standard chosen for purposes of comparison was the average monthly sales during the year, and this quantity was rated at 100. The sales for each month were then calculated as a certain percentage of this standard.

An examination of the table will show that April was the month of lowest sales of permissible explosives; it was also, except for March, the month of lowest sales of black blasting powder and of the production of bituminous coal, in which branch of mining these two classes of explosives are so largely used. Sales of "high" explosives reached the lowest point in December and coincide in this respect with the smallest production of anthracite coal, in which class of mining large quantities of "high" explosives are consumed, although that industry is by no means the largest consumer of high explosives, most of the quantity manufactured being used at metal mines and for general industrial purposes.

Sales of permissible explosives reached their highest mark in January. With this exception, October was the month of greatest activity in the explosives and coal-mining industries.

TABLE 13.—*Monthly fluctuations in sales of explosives and in production of coal, 1921 and 1920.*

(Average monthly quantities=100 per cent.)

Month.	Black blasting powder.	"High" explosives.	Permissible explosives.	Bituminous coal.	Anthracite.	Total coal.
1921.						
January	109.3	93.0	128.8	118.7	100.6	115.4
February	87.5	92.3	83.8	90.9	104.5	93.3
March	80.2	105.0	83.0	89.5	100.5	91.5
April	80.4	108.4	78.8	81.2	104.5	85.3
May	88.2	105.6	99.3	98.2	104.1	99.3
June	103.7	97.0	105.0	99.9	112.0	102.0
July	91.5	89.1	93.5	89.5	95.7	90.6
August	109.4	106.1	100.8	101.8	103.9	102.2
September	113.4	110.4	98.6	103.5	96.7	102.3
October	132.2	114.0	126.7	128.9	102.9	124.2
November	118.6	93.0	106.1	106.1	93.1	103.8
December	85.1	85.6	95.3	91.3	81.2	89.5
1920.						
January	109.1	87.9	99.9	105.0	102.2	104.6
February	99.4	103.1	87.1	86.5	87.9	86.7
March	107.6	126.7	98.4	100.9	105.8	101.6
April	74.6	107.0	82.3	81.8	83.8	82.1
May	95.2	108.8	94.7	85.7	107.2	88.7
June	114.7	107.5	98.8	94.4	110.0	96.5
July	109.2	93.7	103.5	98.2	111.3	100.0
August	108.8	120.6	113.3	104.3	108.1	104.8
September	92.6	105.1	116.6	106.1	[a] 62.6	100.1
October	108.4	94.5	115.1	113.5	108.7	112.8
November	91.3	74.4	94.3	110.0	100.4	108.7
December	89.1	70.7	96.2	113.7	112.1	113.5

[a] A strike in the anthracite field restricted output.

EXPORTS OF EXPLOSIVES, 1913–1921.

Table 14 shows the amount and value of explosives exported from the United States during the years 1913 to 1921, inclusive. The tabulations of exports do not segregate such explosives as picric acid, nitroglycerin, trinitrotoluene, and others. These are grouped in the column headed "All other."

Table 15 shows the amount and value of explosives exported from the United States during 1921 and the countries to which the shipments were made.

TABLE 14.—*Explosives exported from the United States, 1913–1921.*[a]

Years and months.	Cartridges.	Dynamite.		Gunpowder (including smokeless).		Fuses.	Shells and projectiles, loaded.	All other.	Total.
	Value.	Pounds.	Value.	Pounds.	Value.	Value.	Value.	Value.	Value.
1921.									
January	$288,539	1,768,978	$380,333	111,996	$67,008	$42,475	$70,236	$149,349	$997,940
February	118,528	102,660	25,224	23,268	14,667	16,614	36,296	82,273	293,602
March	63,106	469,505	94,247	57,443	8,370	47,853	20,759	49,114	293,449
April	142,169	312,531	64,227	338,531	235,323	31,581	14,293	108,665	586,258
May	72,617	383,625	81,789	2,455	1,387	8,119	21,266	43,567	228,745
June	110,877	341,094	67,015	19,039	8,808	13,087	15,046	26,847	241,680
July	69,162	913,850	160,901	55,157	10,076	15,728	15,415	57,172	328,454
August	103,516	740,620	123,278	51,218	18,413	21,129	15,717	38,676	320,729
September	150,715	615,911	144,700	35,873	9,439	20,931	9,735	53,794	389,314
October	70,392	1,316,206	211,233	119,450	66,194	23,713	8,851	49,689	430,072
November	63,223	753,025	165,579	31,212	20,982	9,843	1,999	79,839	341,465
December	52,208	1,849,437	297,473	20,746	9,183	30,794	4,570	116,618	510,846
Total	**1,305,052**	**9,567,442**	**1,815,999**	**866,388**	**469,850**	**281,867**	**234,183**	**855,603**	**4,962,554**
1920.									
January	486,101	1,059,470	205,220	238,176	98,621	34,863	5,388,746	346,216	6,559,767
February	432,785	802,399	170,252	63,447	26,566	74,390	52,751	213,447	970,191
March	1,037,211	1,781,445	361,166	183,117	86,812	71,955	94,774	199,296	1,851,214
April	448,743	1,115,781	231,917	236,191	101,434	46,844	105,108	177,281	1,111,327
May	648,356	1,648,445	352,866	133,987	69,972	91,669	106,997	247,719	1,517,579
June	615,015	734,234	150,039	120,316	34,157	64,203	143,588	111,725	1,118,727
July	398,383	3,061,765	620,079	164,317	90,764	60,477	71,100	223,332	1,464,135
August	315,827	1,002,740	205,477	138,907	54,703	84,020	66,595	193,429	920,051
September	445,899	1,396,834	258,861	7,197,233	7,192,583	33,595	31,850	119,228	8,082,016
October	450,895	1,728,169	350,586	21,526,436	21,488,601	68,855	63,733	233,884	22,656,554
November	365,439	518,954	120,509	4,403,382	4,372,204	47,458	52,680	121,681	5,079,971
December	327,668	791,745	183,509	9,502,284	4,751,740	57,896	100,112	94,241	5,515,166
Total	**5,972,322**	**15,641,981**	**3,210,481**	**43,907,793**	**38,368,157**	**736,225**	**6,278,034**	**2,281,479**	**56,846,698**
Total, 1919	**10,346,957**	**11,173,528**	**2,370,016**	**6,751,799**	**5,990,744**	**600,718**	**6,800,891**	**2,290,381**	**28,399,707**
Total, 1918	**10,764,765**	**18,204,644**	**4,845,888**	**229,377,058**	**179,648,156**	**3,050,257**	**3,812,608**	**41,406,865**	**243,528,539**
Total, 1917	**42,122,656**	**17,930,665**	**3,953,374**	**438,459,254**	**337,904,687**	[b]**16,945,589**	[b]**36,755,525**	**202,252,574**	**639,934,405**
Total, 1916	**55,103,904**	**18,681,285**	**4,173,175**	**313,648,981**	**262,161,593**	(c)	(c)	**394,136,334**	**715,575,306**
Total, 1915	**25,408,079**	**11,446,368**	**1,509,050**	**84,358,379**	**66,922,807**	(c)	(c)	**95,129,957**	**188,969,893**
Total, 1914	**6,567,122**	**11,303,315**	**1,213,600**	**866,569**	**289,893**	(c)	(c)	**1,966,972**	**10,037,587**
Total, 1913	**3,015,399**	**13,403,616**	**1,498,222**	**1,284,422**	**359,855**	(c)	(c)	**651,601**	**5,525,077**

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[a] Compiled from "Monthly Summary of Foreign Commerce of the United States," published by the Bureau of Foreign and Domestic Commerce, Department of Commerce.

[b] July 1 to Dec. 31.

[c] Not segregated.

TABLE 15.—*Explosives exported from the United States, by countries in 1921 and 1920.*[a]

Countries.	Cartridges.	Dynamite.		Gunpowder.		Fuses.	Shells.	All other.	Total, 1921.	Total, 1920.
	Value.	Pounds.	Value.	Pounds.	Value.	Value.	Value.	Value.	Value.	Value.
Azores, and Maderia Islands	$250								$250	$661
Belgium	8,865					$1,224	$961		11,050	187,684
Denmark	5,693							$374	6,067	15,886
Finland	1,741								1,741	16,396
France	1,074			138,900	$92,896	2,136		60	96,166	37,661,735
Germany	3,691							410	4,101	5,142
Gibralter								51	51	
Greece	18,549			140,000	109,200		9,760	14,067	151,576	171,449
Iceland and Faroe Islands	125								125	5,879
Italy	2,431						72	74	2,577	192,774
Malta, Gozo, and Cyprus Islands										500
Netherlands	819						165	65	1,049	1,058
Norway	2,909					25	340	558	3,832	47,801
Poland and Danzig										5
Portugal	1,125			51	42	506	127		1,800	36,120
Rumania	456								456	20
Russia in Europe										5,444,810
Spain	33,377			110,340	62,316	362	475	8,249	104,779	88,023
Sweden	19,772					32	17	2,133	21,954	45,529
Switzerland						25			25	1,384
Turkey in Europe	25								25	1,218
England	48,355			200	144	5,474	3,254	1,274	58,501	182,983
Scotland								25	25	2,186
Bermuda	160			500	125	424	26	709	1,444	664
British Honduras	6,273	1,700	$388	5,073	1,607	70	6,138	1,679	16,155	22,992
Canada	220,250	209,275	44,913	48,471	45,700	9,490	22,329	160,665	503,347	1,211,450
Costa Rica	2,370	60,000	10,363	5,384	2,198	3,573	481	2,571	21,556	91,175
Guatemala	724	25,000	5,190	95,013	15,452	2,379	83	2,820	26,648	28,125
Honduras	11,397	120,300	22,410	21,500	2,180	7,671	57	12,872	56,587	138,434
Nicaragua	3,358	161,984	33,793	200	103	5,722	149	5,673	48,798	118,219
Panama	49,212	20,000	4,812	9,265	3,444	10,255	4,195	22,282	94,200	112,341
Salvador	11,310	2,500	550			202	50	1,323	13,435	30,755
Mexico	146,335	5,089,229	879,353	142,206	40,458	107,255	41,840	226,487	1,441,728	2,214,409
Miquelon, Langley, etc	21						977		998	
Newfoundland and Labrador	5,086					752	1,080	180	7,098	30,132
Barbados	924						375	108	1,407	1,840
Jamaica	2,236	20,425	3,961	125	42	1,972	4,555	1,319	14,085	20,027
Trinidad and Tobago	2,889					139	1,511	644	5,183	9,270
Other British West Indies	2,617	300	108	275	124	236	574	677	4,336	5,503
Cuba	67,188	650,488	131,545	20,160	9,073	22,065	26,276	32,897	289,044	852,816
Virgin Islands of the United States	244	1,500	364				299	611	1,518	2,491
Dutch West Indies	423					22	197	3,773	4,415	2,542
French West Indies	18					48		38	104	1,316
Haiti	2,175	1,160	247	400	168	917	217	1,012	4,736	1,898
Dominican Republic	2,057			2,050	785	304	110	9,141	12,397	25,621

Argentina	156,426	253,000	67,954	8,130	6,302	5,008	20,971	46,737	303,398	856,944
Bolivia	6,032	658,000	176,687	2,375	1,938	35,004	635	32,552	252,848	119,728
Brazil	68,752	77,063	19,640	....	....	3,379	5,734	19,006	116,511	2,002,275
Chile	62,563	411,626	81,854	3,250	2,897	2,767	15,994	93,895	259,970	861,768
Colombia	21,208	38,750	12,692	26,367	10,509	2,028	2,516	9,092	58,045	404,038
Ecuador	8,059	178,200	32,693	3,000	1,014	347	389	8,311	50,813	106,211
British Guiana	353	....	....	....	....	....	....	387	740	19,975
Dutch Guiana	226	....	....	....	....	....	....	58	284	14,187
French Guiana	63	....	....	....	....	....	....	....	63	83
Paraguay	1,781	....	....	....	....	....	....	....	1,781	34,503
Peru	16,939	1,126,922	183,671	3,000	1,570	24,824	2,008	69,638	298,650	761,448
Uruguay	6,113	34,700	11,938	37,040	24,276	1,696	2,830	2,340	49,193	137,895
Venezuela	764	19,670	4,851	11,446	6,418	277	....	6,781	19,091	87,602
China	5,566	50,000	14,295	....	....	4,749	88	8,654	33,352	119,587
Kwantung, leased territory	35	....	....	....	....	....	....	....	35	11,370
Chosen	3,822	....	....	....	....	....	432	237	4,491	1,972
British India	35,707	....	....	....	....	265	3,685	3,492	43,149	40,317
Straits Settlements	2,855	....	....	....	....	17	58	....	2,930	12,989
Other British East Indies	5,007	....	....	....	....	....	180	370	5,557	4,809
Dutch East Indies	6,776	50,750	15,097	....	....	3,265	5	3,583	28,726	284,666
French East Indies	2,005	....	....	....	....	....	....	....	2,005	1,860
Hongkong	3,017	....	....	....	....	886	288	785	4,976	8,622
Japan	21,134	....	....	696	382	796	2,058	4,319	28,689	74,712
Russia in Asia	35,237	....	....	7,310	3,771	....	5,095	3,423	47,526	69,154
Siam	130	....	....	....	....	....	35	....	165	27,331
Turkey in Asia	54	....	....	....	....	....	....	....	54	234
Australia	62,253	....	....	6,113	3,703	696	21,334	13,155	101,141	1,137,983
New Zealand	28,925	....	....	17,048	20,763	323	1,843	89	51,943	225,605
Other British Oceania	2,242	....	....	....	....	....	784	73	3,099	3,279
French Oceania	936	8,600	3,730	500	250	9	28	303	5,256	5,665
Other Oceania	60	....	....	....	....	....	....	....	60	7,567
Philippine Islands	21,271	296,300	52,900	....	....	11,144	10,324	12,514	108,153	208,007
Abyssinia	5,037	....	....	....	....	....	....	....	5,037	....
Belgian Kongo	91	....	....	....	....	....	46	....	137	3,537
British West Africa	649	....	....	....	....	....	....	211	860	10,352
British South Africa	12,084	....	....	....	....	1,071	5,244	80	18,479	92,454
British East Africa	1,774	....	....	....	....	....	485	76	2,335	7,845
Canary Islands	308	....	....	....	....	....	....	417	725	2,792
French Africa	212	....	....	....	....	....	38	....	250	2,193
Kamerun, etc	....	....	....	....	....	....	....	....	....	524
Liberia	1,545	....	....	....	....	....	23	14	1,582	1,859
Morocco	2,800	....	....	....	....	....	....	140	2,940	2,597
Portuguese Africa	1,364	....	....	....	....	36	107	50	1,557	6,504
Egypt	6,353	....	....	....	....	....	4,236	....	10,589	32,392
Total, 1921	**1,305,052**	**9,567,442**	**1,815,999**	**866,388**	**469,850**	**281,867**	**234,183**	**855,603**	**4,962,554**	....
Total, 1920	5,972,322	15,641,981	3,210,481	43,907,793	38,368,157	736,225	6,278,034	2,281,479	....	56,846,698

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[a] Compiled from office records in the Bureau of Foreign and Domestic Commerce, Department of Commerce.

NOTE.—There were no exports in 1920 or 1921 to the following countries: Austria, Bulgaria, Czechoslovakia, Hungary, Ireland, Yugoslavia, Albania, etc., Greenland, Falkland Islands, Aden, Portuguese East Indies, Persia, Other Asia, Italian Africa, Madagascar, and Spanish Africa.

PUBLICATIONS ON INVESTIGATIONS OF EXPLOSIVES.

A limited supply of the following publications of the Bureau of Mines has been printed and is available for free distribution until the edition is exhausted. Requests for all publications can not be granted, and to insure equitable distribution applicants are requested to limit their selection to publications that may be of especial interest to them. Requests for publications should be addressed to the Director, Bureau of Mines.

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PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION.

BULLETIN 17. A primer on explosives for coal miners, by C. E. Munroe and Clarence Hall. 1911. 61 pp., 10 pls., 12 figs.

BULLETIN 48. The selection of explosives used in engineering and mining operations, by Clarence Hall and S. P. Howell. 1914. 50 pp., 3 pls., 7 figs..

BULLETIN 59. Investigations of detonators and electric detonators, by Clarence Hall and S. P. Howell. 1913. 73 pp., 7 pls., 5 figs.

BULLETIN 80. A primer on explosives for metal miners and quarrymen, by C. E. Munroe and Clarence Hall. 1915. 125 pp., 51 pls., 17 figs.

BULLETIN 96. The analysis of permissible explosives, by C. G. Storm. 1916. 88 pp., 3 pls., 7 figs.

BULLETIN 137. The use of permissible explosives in the coal mines of Illinois, by J. R. Fleming and J. W. Koster. 1917. 106 pp.

BULLETIN 196. Coal-mine fatalities in the United States, 1919, and coal-mine statistics supplementing those published in Bulletin 115, with list of permissible explosives, lamps, and motors tested prior to Jan. 31, 1920, by A. H. Fay. 1920. 86 pp.

BULLETIN 198. Regulation of explosives in the United States, by C. E. Munroe. 1921. 45 pp.

TECHNICAL PAPER 7. Investigations of fuse and miners' squibs, by Clarence Hall and S. P. Howell. 1912. 19 pp.

TECHNICAL PAPER 17. The effect of stemming on the efficiency of explosives, by W. O. Snelling and Clarence Hall. 1912. 20 pp., 11 figs.

TECHNICAL PAPER 78. Specific gravity separation applied to the analysis of mining explosives, by C. G. Storm and A. L. Hyde. 1914. 14 pp.

TECHNICAL PAPER 89. Coal-tar products and the possibility of increasing their manufacture in the United States, by H. C. Porter, with a chapter on coal-tar products used in explosives, by C. G. Storm. 1915. 21 pp.

TECHNICAL PAPER 125. The sand test for determining the strength of detonators, by C. G. Storm and W. C. Cope. 1916. 68 pp., 2 pls., 5 figs.

TECHNICAL PAPER 145. Sensitiveness to detonation of trinitrotoluene and tetranitromenthylanilin, by G. B. Taylor and W. C. Cope. 1916. 11 pp.

TECHNICAL PAPER 160. The determination of nitrogen in substances used in explosives, by W. C. Cope and G. B. Taylor. 1917. 46 pp., 1 pl., 4 figs.

TECHNICAL PAPER 162. Initial priming substances for high explosives, by G. B. Taylor and W. C. Cope. 1917. 32 pp.

TECHNICAL PAPER 186. Methods of routine work in the explosives physical laboratory of the Bureau of Mines, by S. P. Howell and J. E. Tiffany. 1918. 63 pp.

TECHNICAL PAPER 210. An analytical method for detecting blown-out shots in coal mines, by G. F. Hutchinson and J. Barab. 1919. 22 pp.

TECHNICAL PAPER 234. Sensitiveness of explosives to frictional impact, by S. P. Howell. 1919. 17 pp., 2 pls., 1 fig.

TECHNICAL PAPER 243. Development of liquid oxygen explosives during the war, by G. S. Rice. 1920. 46 pp., 2 pls., 6 figs.

TECHNICAL PAPER 291. The production of explosives in the United States during the Calendar Year 1920, by W. W. Adams. 1921. 44 pp., 4 figs.

MINERS' CIRCULAR 7. Use and misuse of explosives in coal mining, by J. J. Rutledge, with a preface by J. A. Holmes. 1913. 52 pp., 8 figs.

MINERS' CIRCULAR 19. The prevention of accidents from explosives in metal mining, by Edwin Higgins. 1914. 16 pp., 11 figs.

PUBLICATIONS THAT MAY BE OBTAINED ONLY THROUGH THE SUPERINTENDENT OF PUBLIC DOCUMENTS.

BULLETIN 10. The use of permissible explosives, by J. J. Rutledge and Clarence Hall. 1912. 34 pp., 5 pls., 4 figs. 10 cents.

BULLETIN 15. Investigations of explosives used in coal mines, by Clarence Hall, W. O. Snelling, and S. P. Howell, with a chapter on the natural gas used at Pittsburgh, by G. A. Burrell, and an introduction by C. E. Munroe. 1911. 197 pp., 7 pls., 5 figs. 25 cents.

BULLETIN 51. The analysis of black powder and dynamite, by W. O. Snelling and C. G. Storm. 1913. 80 pp., 5 pls., 5 figs. 10 cents.

BULLETIN 66. Tests of permissible explosives, by Clarence Hall and S. P. Howell. 1913. 313 pp., 1 pl., 6 figs. 25 cents.

TECHNICAL PAPER 12. The behavior of nitroglycerin when heated, by W. O. Snelling and C. G. Storm. 1912. 14 pp., 1 pl., 2 figs. 5 cents.

TECHNICAL PAPER 18. Magazines and thaw houses for explosives, by Clarence Hall and S. P. Howell. 1912. 34 pp., 1 pl., 5 figs. 10 cents.

TECHNICAL PAPER 69. Production of explosives in the United States during the calendar year 1912, compiled by A. H. Fay. 1914. 8 pp. 5 cents.

TECHNICAL PAPER 146. The nitration of toluene, by E. J. Hoffman. 1916. 32 pp. 5 cents.

TECHNICAL PAPER 159. Production of explosives in the United States during the calendar year 1915, with notes on coal-mine accidents due to explosives, and a list of permissible explosives, lamps, and motors tested prior to June 1, 1916, compiled by A. H. Fay. 1916. 24 pp. 5 cents.

TECHNICAL PAPER 169. Permissible explosives tested prior to Jan. 1, 1917, by S. P. Howell. 1917. 19 pp. 5 cents.

TECHNICAL PAPER 175. Production of explosives in the United States during the calendar year 1916, by A. H. Fay. 1917. 24 pp. 5 cents.

TECHNICAL PAPER 192. Production of explosives in the United States during the calendar year 1917, with notes on coal-mine accidents due to explosives and list of permissible explosives tested prior to Apr. 30, 1918, by A. H. Fay. 1918. 5 cents.

TECHNICAL PAPER 231. Production of explosives in the United States during the calendar year 1918, by A. H. Fay. 1919. 21 pp. 5 cents.

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